Preprint
UCRL-JC-145807

Djehuty: A Code for Modeling Whole Stars in Three Dimensions

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This article was submitted to
Radial and Non-Radial Pulsations as Probes of Stellar Physics,
Leuven, Belgium, July 26-31, 2001

U.S. Department of Energy

Lawrence
Livermore
National
Laboratory

October 9, 2001

TITLE
ASP Conference Series, Vol. **VOLUME**, **PUBLICATION YEAR**
EDITORS

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Lawrence Livermore National Laboratory, Livermore, CA, USA

Abstract. The DJEHUTY project is an intensive effort at the Lawrence Livermore National Laboratory (LLNL) to produce a general purpose 3-D stellar structure and evolution code to study dynamic processes in whole stars.

1. Introduction

Stellar models in 1-D work remarkably well for most stars. However, stars are three dimensional objects and the computing power is now at a point where we can do better than 1-D models for modeling the large array of physical processes occurring in stars for which spherical symmetry is no longer a valid approximation. With a 3-D stellar code one can tackle the problems linked to rotation, turbulent motions and convection, magnetism, binarity, and explosive phases of stellar evolution in a consistent and physically meaningful way.

The DJEHUTY code is an evolution of a radiation hydrodynamics code developed over decades at LLNL. It is our goal to provide the astrophysical community with the first general purpose 3-D stellar structure and evolution code suitable to study the whole gamut of dynamical processes occurring in stars.

2. The DJEHUTY code

At the heart of DJEHUTY is an Arbitrary Lagrangian-Eulerian (ALE; Barton 1985) code for radiation hydrodynamics which treats radiation transport in the diffusion approximation. Microscopic physics appropriate for stars has been added. The opacities used are those of OPAL (Iglesias & Rogers 1996) for high temperatures and Alexander (Alexander & Ferguson 1994) for low temperatures. A set of Planck opacities computed from the OP data (Seaton et al. 1994) is being used within the hydro code to couple the radiation to the

[1]This work was performed under the auspices of the U.S. Department of Energy, National Nuclear Security Administration by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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